Enterprise Risk Management and the Cost of Capital

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Abstract

Enterprise Risk Management (ERM) is a process that manages all risks in an integrated, holistic fashion by controlling and coordinating offsetting risks across the enterprise. This research investigates whether the adoption of the ERM approach affects firms' cost of equity capital. We restrict our analysis to the U.S. insurance industry to control for unobservable differences in business models and risk exposures across industries. We simultaneously model firms' adoption of ERM and the effect of ERM on the cost of capital. We find that ERM adoption significantly reduces firm's cost of capital. Our results suggest that cost of capital benefits are one answer to the question how ERM can create value.

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Introduction

Enterprise Risk Management (ERM) is a holistic approach to risk management. Traditionally, corporations managed risks arising from their business units separately in each unit. ERM improves on this traditional "silo" based approach by coordinating and controlling offsetting risks across the enterprise. A number of surveys document how firms implement ERM programs to achieve such synergies between different risk management activities (see, e.g., Colquitt, Hoyt, and Lee, 1999; Kleffner, Lee and McGannon, 2003; Beasley, Clune and Hermanson, 2005; Altuntas, Berry-Stölzle, and Hoyt, 2011), a number of studies on firms' decision to start an ERM program provide evidence that firms' adopt ERM for direct economic benefits (see, e.g., Liebenberg and Hoyt, 2003; Pagach and Warr, 2011), and a limited number of studies provide evidence that ERM is associated with improvements in firm performance and increases in firm value (see, e.g., Grace et al., 2010; Liebenberg and Hoyt, 2011; Eckles, Hoyt, and Miller, 2012). While this prior literature argues that ERM can create value by creating synergies between different risk management activities, increasing capital efficiency, avoiding the underinvestment problem in financially constrained firms, and by reducing the cost of external financing, there is a lack of empirical evidence supporting these claims.

The goal of our research is to shed some light on the fundamental question *how* ERM can create value. We specifically focus on the relationship between ERM adoption and firms' cost of external financing and investigate whether ERM adoption is negatively associated with the cost of equity capital. Such a research design allows us to evaluate whether cost of capital benefits are one mechanism for value creation by the ERM approach. In addition, such a research design provides evidence on whether stockholders of firms view ERM as a beneficial and value enhancing activity or not.

To avoid possible spurious correlations caused by unobservable differences in business models and risk exposures across industries, we restrict our analysis to a single industry that is almost tailor made for an empirical analysis of ERM programs and their cost of capital implications: the U.S. insurance industry. The insurance industry embraced the ERM approach and a substantial fraction of insurers adopted an ERM program, providing the necessary variation for an empirical analysis. In addition, the U.S. insurance industry is the only insurance industry worldwide with a substantial number of publicly traded stock companies, providing the necessary stock price data for cost of equity capital calculations.

Our cost of capital measure is based on the Gebhardt, Lee and Swaminathan (2001) implied cost of capital model, which equates the firm's market value of equity with its discounted future cash flow estimates, and solves for the required internal rate of return. We use an implied cost of capital measure because such measures better explain variations in expected stock returns than realized stock returns (see, e.g., Gebhardt, Lee and Swaminathan, 2001; Pástor, Sinha, and Swaminathan, 2008). We follow the procedure suggested by Beasly, Pagach, and Warr (2008), Liebenberg and Hoyt (2011), and Pagach and Warr (2011) and systematically search newswires and other media for evidence of ERM program adoption by our sample insurance companies. We then use two procedures to test whether ERM adoption is actually accompanied by a decrease in firms' cost of capital. First, we use an event study methodology and test for an abnormal reduction in the cost of capital around the year of ERM adoption. Second, we explicitly model the determinants of ERM program adoption and estimate a two-equation treatment effects model to assess the effect of ERM adoption on firms' cost of capital. The ERM indicator variable in this model is coded equal to one in the year of ERM adoption; the variable is equal to zero in the years prior to ERM adoption. To specifically focus on the effect of ERM *adoption* in the analysis and to ensure that our results are not confounded by firm-specific changes in the business environment of ERM adopters over longer timer periods, we remove observations of ERM adopters in years after ERM adoption from the sample.

In both the event study as well as the treatment effects model, we find that ERM adoption is significantly associated with a reduction in firms' cost of equity capital. Overall, our results suggest that cost of capital benefits are one answer to the question how ERM can create value.

The paper proceeds as follows. In the next section, we discuss related literature and the conceptual background of our research design. This is followed by a description of the data and methodology used, and a section containing the results. The final section concludes.

Literature and Conceptual Background

ERM Literature

The literature on ERM follows three main themes. The first strand of literature is mainly descriptive and focuses on the question how firms implement ERM programs in praxis (see, e.g., Colquitt, Hoyt, and Lee, 1999; Kleffner, Lee and McGannon, 2003; Beasley, Clune and Hermanson, 2005; Altuntas, Berry-Stölzle, and Hoyt, 2011). Kleffner, Lee, and McGannon's (2003) survey includes a question on the reasons to implement an ERM program; the top three reasons include the "influence of the risk managers," "encouragement from the board of directors," and "compliance with the Toronto Stock Exchange guidelines."

The second strand of literature examines the relationship between firm-specific characteristics and the firms' decision to adopt the ERM approach. Liebenberg and Hoyt (2003) find that firms with greater financial leverage are more likely to appoint a CRO; they interpret their result as evidence that firms start ERM programs to reduce information asymmetries regarding the firm's risk profile. Pagach and Warr (2011) document that a firm's likelihood to adopt ERM is determined by firm size, volatility, institutional ownership, and the CEO's risk taking incentives. For their subsample of banks, Pagach and Warr also document that banks with lower levels of Tier 1 capital are more likely to start an ERM program. Overall, Pagach and Warr's results support the notion that firms engage in ERM for direct economic benefit and not just to comply with regulation.

A third strand of literature investigates the value implications of ERM adoption. Grace et al. (2010) use the detailed Tillinghast Towers Perrin ERM survey of the insurance industry, and provide evidence that ERM improves firm operating performance. More precisely, they document that firms with ERM programs experience higher levels of cost efficiency and return on assets. The authors also find that life insurers benefit more from the development and use of economic capital models than property-casualty insurers. Hoyt and Liebenberg (2011) examine the value implications of ERM program adoption in a two-equation treatment effects model, in which the first stage equation describes firms' selection of the ERM approach. Using Tobin's Q as a proxy for firm value, they document a positive relationship between firm value and ERM adoption. Eckles, Hoyt, and Miller (2012) find that firms with ERM programs experience a reduction in stock return volatility, which becomes stronger over time. They also find that firms' operating profits per unit of risk increase after ERM adoption.

Cost of Capital Literature

The cost of equity capital is the rate of return required by the shareholders on a company's equity, and then the company uses such a rate to discount the cash flows on its new projects. Investors expect a higher rate of return from a more risky firm, and a lower return from a less risky one (Brealey, Myers, and Allen, 2011). Traditionally researchers relied on ex-post average realized returns to measure ex-ante expected returns. Many textbooks in corporate finance suggest so. Expected returns can also be estimated using asset pricing models such as the CAPM and the Fama and French (1993) three-factor model, but those estimates also are based on realized returns. Fama and French (1997) use such method to estimate the cost of capital of 48 value-weighted industries in the U.S. Two recent insurance studies investigate the cost of capital for the U.S. insurers, and they both employ the asset-pricing-model based estimation method. Cummins and Phillips (2005) estimate cost of equity for the property-liability insurers using CAPM and FF3 models, and then further decompose it by line of insurance using the full-information industry beta (FIB) method. They find that the cost of equity estimates are sensitive to the models selected, and are significantly different across lines within property-liability insurance industry. Wen et al. (2008) compare the estimated cost of capital of property-liability insurers from CAPM to that from the Rubinstein-Leland (RL) model. Their major finding is that the estimates are significantly different for insurers with asymmetric returns and small insurers, which should use RL model instead of CAPM to estimate their cost of capital.

Despite its popularity in the past, many researchers (see, e.g., Blume and Friend, 1973; Sharpe, 1978; Froot and Frankel, 1989; Elton, 1999) have recently claimed that using realized returns to proxy for expected returns produces a great amount of noises. Elton (1999) supports this argument by showing that average realized returns can diverge substantially from expected returns over lengthy periods of time. Furthermore, the expected returns estimated using asset pricing models based on realized returns are infamously imprecise as well (see, e.g., Fama and French, 1997). In addition, Pástor, Sinha, and Swaminathan (2008) criticize that the realized returns based measure captures time variation in expected stock returns inefficiently. To address the deficits of the realized returns based estimates, recent accounting and finance researches (see, e.g., Gordon and Gordon, 1997; Claus and Thomas, 2001; Gebhardt, Lee, and Swaminathan, 2001; Easton, 2004; Ohlson and Juettner-Nauroth, 2005) suggest an alternative methodology to estimate expected returns: the *implied cost of capital (ICC)*. The *ICC* of a firm is the internal rate of return that equates the firm's current stock price to the present value of expected future cash flows to equity. Putting differently, the *ICC* is the discount rate that the market implicitly utilizes to discount the firm's expected cash flows. In this manner, the deficiencies involved with relying on noisy realized returns or on any specific asset pricing model are effectively avoided by the *ICC* measure, which derives estimates of expected return directly from market equity prices and cash flow forecasts.

ERM and its Impact on the Cost of Capital

This section provides theoretical arguments for why ERM should decrease the cost of capital of a firm. A firm's cost of capital is directly impacted by its risk profile. In essence, investors require a higher rate of return, equivalently a higher cost of equity capital, from a more risky company compared to a less risky one (Brealey, Myers, and Allen, 2011). ERM coordinates risk management activities across all business units of a firm and treats risks with a holistic approach. Hence, natural hedges across various types of risks enable firms to reduce expenditures related to different risk management activities, optimizing resource allocation and improving capital efficiency as well as return on equity. Furthermore, ERM can reduce a firm's overall risk by reducing the firm's earnings volatility (Hoyt and Liebenberg, 2011). Treating risks in "silos", traditional risk management decreases earnings volatility from a specific risk source (e.g., fire risk, operational risk, commodity price risk, etc.). However, potential interdependencies among risk classes might be overlooked. In contrast, ERM offers a framework that integrates all risk management activities into one unified structure that assists the identification of such interdependencies. Thus, an ERM engagement not only reduces earnings volatility arising from specific risk sources, but also prevents aggregation of risk across different sources.

ERM adoption improves the information available to the firm about its risk profile. This information can be shared with investors, leading to an increase in transparency about the firm's future earnings distribution. Improved disclosures of risk profiles are especially important for firms with complex operations because such firms are difficult to evaluate from the outside. Thus, improved disclosures and information sharing with investors can help to mitigate information asymmetries and should result in a lower cost of capital (see, e.g., Verrecchia, 2001; Lambert, Leuz, and Verrecchia, 2007; Hail and Leuz, 2009). In addition, improved disclosures of risk profiles can serve as a signal of firms' commitment to risk management.

An additional benefit of an ERM program is simply a better risk identification process. ERM is a structured approach to look at all risks faced by the enterprise in a holistic way, which may screen for risks outside the standard risk silos and identify previously overlooked threats to the firm. Improved risk identification allows firms to choose the most effective tool to manage the identified risks instead of passively retaining them.

For insurance companies it is important to have a strong financial strength rating. Standard & Poor's as well as other rating agencies explicitly evaluate insurance company's ERM program as part of the rating process. For instance, in October 2005 Standard & Poor's announced that with the emergence of ERM, risk management will become a separate, major category of its analysis. In February 2006, A.M. Best, the major rating agency in insurance industry, released a special report describing its increased focus on ERM in the rating process. Therefore, having a well-functioning outstanding ERM program positively impact an insurance company's rating, which is monitored by the insurer's clients as well as by outside investors. The link between ERM programs and financial strength ratings creates an additional channel through which ERM adoption should lead to lower cost of capital for insurance companies.

In summary, we can state the following testable hypothesis for ERM adopting firms:

Hypothesis: *ERM adoption reduces the cost of equity capital for firms.*

Data and Methodology

Implied Cost of Equity Capital Measure

We follow Pástor, Sinha, and Swaminathan (2008) and Campell, Dhaliwal, and Schwartz (2012), and estimate the implied cost of capital by using the Gebhardt, Lee, and Swaminathan (2001) model. The model is based on the theory of dividend discount model, but presents firm value using accounting numbers. Gebhardt, Lee, and Swaminathan refer it as the residual income valuation model, which equates the firm's market equity price to the discounted value of its expected future dividends—free cash flows to equity. Thus:

$$P_t = \sum_{i=1}^{\infty} \frac{E_t(D_{t+i})}{(1+r_{icc})^i} \tag{1}$$

where

P_t = price per share of common stock at the end of year t,

$E_t(D_{t+i})$ = expected future dividends for period $t+i$, conditional on the information available at time t, and

r_{icc} = implied cost of equity capital at time t.

According to the "clean surplus" accounting rules[1], the market equity price defined in Equation (1) can be rewritten as the sum of the firm's book value and perpetuity of the residual income:

$$P_t = B_t + \sum_{i=1}^{\infty} \frac{E_t[NI_{t+i} - r_{icc}B_{t+i-1}]}{(1+r_{icc})^i}$$

[1] Clean suplus accounting requires that the earnings to incorporate all gains and losses that impact the book value. Therefore the firm's current book value is expressed as $B_t = B_{t-1} + NI_t - D_t$.

$$= B_t + \sum_{i=1}^{\infty} \frac{E_t[(ROE_{t+i} - r_{icc})B_{t+i-1}]}{(1+r_{icc})^i} \quad (2)$$

where

B_t = book value at the end of period t divided by the number of common shares outstanding at the end of period t,

NI_{t+i} = net income for period $t+i$, and

ROE_{t+i} = after-tax return on book equity for period $t+i$.

The firm value in Equation (2) is expressed as an infinite series. For the sake of practical calculation, we divide this intrinsic value into three parts. The first part includes the explicitly forecasted earnings for the next three years, using the earnings per share forecasts by analysts in I/B/E/S. Then, we forecast earnings implicitly from year *t+4* to year *t+12*, by mean reverting the third period ROE to the twelfth period median industry ROE [2]. We use the simple linear interpolation between year *t+3* ROE and the industry median ROE for the mean reversion process. Lastly, the terminal value (TV) beyond year 12 is estimated by calculating the year 12's present value of the residual income as a perpetuity. By doing this, we assume that any growth in cash flows or earnings after year 12 is value neutral. In this study, we forecast earnings up to 12 years. According to Gebhardt, Lee, and Swaminathan (2001), the "results are very similar" if a 6, 9, 15, 18, or 21 years cutoff is used.

The practical version of Equation (2) for the purpose of computation is presented as follows, and we solve for the internal rate of return r_{icc}:

$$P_t = B_t + \frac{FROE_{t+1} - r_{icc}}{(1+r_{icc})} B_t + \frac{FROE_{t+2} - r_{icc}}{(1+r_{icc})^2} B_{t+1} + TV_t, \quad (3)$$

where

[2] Following Gebhardt, Lee, and Swaminathan (2001), loss firms are excluded when calculating the industry median ROE.

$$TV_t = \sum_{i=3}^{T-1} \frac{FROE_{t+i} - r_{icc}}{(1+r_{icc})^i} B_{t+i-1} + \frac{FROE_{t+T} - r_{icc}}{r_{icc}(1+r_{icc})^{T-1}} B_{t+T-1},$$

$FEPS_{t+i}$ = forecasted earnings per share for year $t + i$. $FEPS_1$ and $FEPS_2$ are equal to the one- and two-year-ahead consensus EPS forecasts, $FEPS_3$ is equal to the three-year-ahead consensus EPS forecast when available, and $FEPS_2 \cdot (1 + LTG)$ when not available,

$FROE_{t+i}$ = forecasted return on equity (ROE) for period $t + i$. For years one through three, this variable is equal to $FEPS_{t+i} / B_{t+i-1}$. Beyond year three, $FROE_{t+i}$ is a linear interpolation to the industry median ROE. Industry median ROE is defined as the moving median ROE for the prior 5–10 years for the firms industry (excluding loss firm-years),

$B_{t+i} = B_{t+i-1} + FEPS_{t+i} \cdot (1 - k)$,

k = current dividend payout ratio, which is the actual dividends from the most recent fiscal year divided by earnings over the same time period for firms with positive earnings, or divided by 0.06*total assets for firms with negative earnings, and

T= forecast horizon, T= 12.

The resulting r_{icc} is the implied cost of equity capital (ICC) for a certain firm in a particular year. Consistent with the previous literature, we collect analysts' forecasts from the I/B/E/S database as of June in the following year, and we calculate the *ICC* as of June of that year (see, e.g., Gebhardt, Lee, and Swaminathan, 2001; Dhaliwal, Heitzman, and Li, 2006; Pástor, Sinha, and Swaminathan, 2008). Following prior studies (see, e.g., Campell, Dhaliwal, and Schwartz, 2012), we winsorize this *ICC* measure from above at 0.5. Figure 1 presents the annual median cost of equity capital over time for all insurance companies in our sample, as well as for the two subsamples of life and non-life insurers.

Measure of ERM Adoption

With regard to the identification of ERM adoption for the sample firms, we employ the widely accepted approach in the ERM literature (see, e.g., Liebenberg and Hoyt, 2011; Pagach and Warr, 2011; Eckles, Hoyt, and Miller, 2012). Specifically, we use a two-step search process. In the first step, we conduct a comprehensive search for each insurer in newswires and other media for statements about an ERM program; the search includes Factiva, LexisNexis, Google search, and other search engines. In the second step, we identify the firm's ERM activity through detailed searches in their financial reports, and data libraries including Thomson One, Mergent Online, and SEC filing databases. We search ERM-related key phrases and their abbreviations, in conjunction with the individual firm names. Key phrases used in the search include "enterprise risk management," "chief risk officer," "risk committee," "strategic risk management," "consolidated risk management," "holistic risk management," and "integrated risk management" in different variations. We then manually review each search result to determine whether it is associated to the firm's ERM adoption, making sure unqualified activities, such as ERM product sales to clients, are excluded. Finally we integrate the results from the two search steps, and identify the earliest evidence of ERM usage for each insurer. Based on the search results we construct the *ERM* indicator variable. To be consistent with our *ICC* measure, we code the ERM indicator for the current year equal to one if a firm adopts ERM between July 1st of the previous year and June 30th of the current year, zero otherwise. The ERM indicator is set to zero for years prior to ERM adoption and one for years after ERM adoption.

Sample Selection

The primary objective of our empirical analysis is to estimate the relation between ERM and firm's cost of equity capital. We focus in our analysis on the U.S. insurance industry for two reasons. First of all, covering multiple industries might result in the spurious correlations arisen from the unobservable regulatory and market differences across industries. The insurance industry has the advantage that a significant portion of firms has adopted the ERM approach, providing the necessary variation for an empirical analysis. The focus of the analysis on firms' cost of capital naturally restricts our sample to publicly traded companies because cost of capital calculations require stock prices. Thus, our initial sample is drawn from the universe of publicly traded insurers (SIC codes between 6311 and 6399) in the merged CRSP/Compustat database for the period 1997–2011[3]. This sample consists of 296 insurers that have operated in any year during the 15-year period.

We exclude firms with missing Compustat data on sales, assets, or equity, and American Depository Receipts. Next, we remove firms with insufficient stock return data from the CRSP monthly stock database. Finally, we match these firms to the I/B/E/S database and eliminate firms that do not have analyst earnings forecasts in I/B/E/S. These screens reduce the sample to 211 firms, or 1413 firm-year observations. 472 of the observations are firm-years with an ERM program in place, and 941 observations are firm-years without an ERM program. Among the sample firms are 113 firms that have adopted ERM by the end of 2011, and 98 firms that did not adopt ERM. Figure 2 displays the cumulative number of sample firms with an ERM program over time.

Changes in Firms' Cost of Capital around the Adoption of ERM

To answer the question whether ERM adoption reduces firm's cost of capital, we first conduct an event study similar to the approach documented in Lee, Mayers and Smith (1997). The idea is to investigate whether the firm's *ICC* drops significantly around its adoption of an

[3] Because the earliest evidence of ERM activity is in 1997, we start our sample in 1997.

ERM program. For the purpose of detecting the "abnormal" change in *ICC*, we obtain the adjusted implied cost of capital for each firm by subtracting the industry average to correct for the industry-wide time trend. We use three ways to calculate insurance industry average *ICC*. Firstly, we use the entire insurance industry to calculate the industry average *ICC* for each year. Secondly, we divide insurers into two sectors by life vs. non-life insurers. Lastly, we separate them into five sectors defined by SIC codes. More specifically, we classify the SIC code of 6311 (life insurers) as sector 1, 6321 and 6324 (accident and health insurers) as sector 2, 6331 and 6399 (property and casualty insurers) as sector 3, 6351 (surety insurers) as sector 4, and 6361 (title insurers) as sector 5. For the second and third methods, after the sub-industry classifications, we calculate each sector's average *ICC*, respectively, and use them as the minuend to compute the firm's industry-adjusted *ICC*. We use multiple event windows including (t - 1, t), (t, t + 1), (t - 1, t + 1), (t - 1, t + 2), and (t - 1, t + 3), where t denotes the year in which a firm engages in ERM.

We subsequently compute the industry-adjusted change in firm i's implied cost of capital within event windows as

$$\Delta AdjICC_i = AdjICC_{i,t+n} - AdjICC_{i,t-n}\,, \tag{4}$$

where

$AdjICC_{i,t} = ICC_{i,t} - IndustryAverage_t$ represents firm i's industry-adjusted *ICC*,

$IndustryAverage_t$ = the average *ICC* across all sample firms, the respective average *ICC* of life and non-life insurers, or the respective average *ICC* of five insurance sectors, and

n = 0, 1, 2, or 3.

Lastly the *t*-test and the Wilcoxon signed-ranks test are employed to investigate whether the industry-adjusted change in implied cost of capital around the ERM adoption differs significantly from zero.

Econometric Considerations

To examine the relation between enterprise risk management and the cost of equity, we follow prior literature and model the cost of equity as a function of firm-specific characteristics (see, e.g., Botosan and Plumlee, 2005; Hail and Leuz, 2006; Dhaliwal, Heitzman, and Li, 2006; Pástor, Sinha, and Swaminathan, 2008; Campell, Dhaliwal, and Schwartz, 2012). One possible approach would be to simply add *ERM* on the right-hand side along with the other independent variables. However, this ignores the fact that some of the factors may simultaneously affect the firm's decision to adopt ERM and the observed differences in *ICC*. In other words, the likely endogeneity issue associated with the ERM choice may produce potential selectivity bias. Moreover, each firm is observed each year, and therefore each firm has up to 15 repeated observations, which raises the potential firm-level clustering issue. Petersen (2009) claims that significance of coefficient estimates would be inflated due to the understated standard errors if firm-level clustering is not corrected for. To address these concerns, we use a maximum-likelihood treatment effects model that jointly estimates the firm's choice to engage in ERM and the effect of that choice (or treatment) on implied cost of capital in a two-equation system. By employing this model, we could effectively evade the endogeneity problem and the firm-level clustering issue.

In this study, we use the within-firm changes in *ICC* (*ΔICC*) between the year before and the year after ERM adoption as the variable to gauge the firm's implied cost of capital. The coefficient of ERM indicator in the treatment effects model basically captures the difference between the treatment group (ERM adopters) and control group (non-adopters). This so-called "difference-in-differences" methodology is common practice in treatment effects literature (see, e.g., Graham, Lemmon, and Wolf, 2002; Villalonga, 2004). By looking at *ΔICC*, we essentially remove the "level" of *ICC* and just focus on changes. By employing such an approach, we control for unobserved firm-specific differences across firms. *ΔICC* essentially measures the growth of implied cost of capital. We expect that the ERM adoption reduces the firm's cost of capital growth. Accordingly, we posit an inverse relationship between *ΔICC* and *ERM*.

Model Specification

The maximum-likelihood treatment effects model consists of two simultaneous equations. The first equation is designed to evaluate the impact of ERM_{it} on ΔICC_{it}, controlling for other determinants of *ΔICC*, which is the major interest of this study. It is expressed as

$$\Delta\, ICC_{i,t+1} = X_{it}\beta + \delta ERM_{it} + \varepsilon_{it}, \tag{5}$$

where ERM_{it} specifies whether firm *i* has adopted ERM program in year *t*, with 1 being positive and 0 negative; X_{it} contains a vector of control variables that explains the variation in firm's implied cost of capital; and ε_{it} is the error term. As discussed earlier, ERM_{it} is an endogenous variable. Estimating the first equation alone would present the biased estimates caused by the endogeneity issue. Therefore, it is crucial to include the second equation that simultaneously model ERM_{it} on the determinants of ERM engagement, which is expressed as

$$ERM_{it} = \omega_{it}\gamma + u_{it}. \tag{6}$$

where ω_{it} is a vector of variables that explains and determines the firm's decision to implement the ERM program; and u_{it} is the error term. In Equations (5) and (6) ε_{it} and u_{it} are assumed to be bivariate normal with mean 0. Equations (5) and (6) are estimated simultaneously using maximum-likelihood methodology. If ε_{it} and u_{it} are correlated, it means that ERM_{it} indeed presents the endogeneity problem, and the effect of ERM on firm's cost of capital will be biased if the maximum-likelihood treatment effects model is not used. The correlation of these two error terms is examined by the likelihood ratio test. Equation (7) and (8) are specific functional forms which include variable lists based on Equation (5) and (6). All the control variables are lagged for two reasons. Firstly, *ΔICC* and *ERM* are supposed to be determined by the previous year's firm- and industry-specific characteristics, and we follow in the precedent in the literature (see, e.g., Campell, Dhaliwal, and Schwartz, 2012). Secondly, *ΔICC* and *ERM* are measured as of June of each year, and the control variables are as of December of each year. Therefore, they are actually only half a year lagged.

$$\Delta ICC = f\,(ERM|\ Beta_{t-1}, Size_{t-1}, Leverage_{t-1}, BooktoMkt_{t-1}, LongGrow_{t-1}, Foredispers_{t-1}, Life_{t-1}, Sector\_ICC_{t-1}, Year\ Dummies). \quad (7)$$

$$ERM = f\,(Size_{t-1}, Leverage_{t-1}, BooktoMkt_{t-1}, Div\_Int_{t-1}, Non\text{-}ins_{t-1}, Opacity_{t-1}, Slack_{t-1}, CV(EBIT)_{t-1}, RetVolatility_{t-1}, ValueChange_{t-1}, Life_{t-1}, Year\ Dummies). \quad (8)$$

Following Villalonga (2004), we focus on the firms that change from non-treatment to treatment, and discard the observations of the subsequent treatment years once the firms have adopted the treatment. We also require the firms' data of previous and following year of treatment available. That is to say, we only retain one year observation per ERM firm since the ERM implementation when it changes from non-ERM adopter to adopter, and keep all the non-ERM firm-years. As a result, our final sample includes 53 ERM firms with data from one year before until one year after ERM adoption, plus the 458 non-ERM firm-years with data on the same firm for the previous year and the following year. There are two reasons why we use such a sample. First of all, plenty can happen after a firm adopts ERM, and these other effects (i.e., confounding effects) may impact the estimated results. In addition, including the subsequent ERM years once a firm has adopted ERM, the treatment effects model implicitly assumes that a firm can switch back and forth between ERM and non-ERM in every single year. However, to the best of our knowledge, we are not aware of any firm that has cancelled its ERM program. Therefore, it is really just a decision to adopt ERM. Dropping observations after ERM adoptions should capture this aspect.

In the treatment effects model of Hoyt and Liebenberg (2011), the observations after ERM adoptions are kept. As a robustness check, we also extend our sample to the one similar to that in Hoyt and Liebenberg (2011).

Discussion of ΔICC Determinants

The *ΔICC* model incorporates common explanatory variables from prior studies (see, e.g., Campell, Dhaliwal, and Schwartz, 2012; Gebhardt, Lee, and Swaminathan, 2001).

Beta

The CAPM suggests a positive linkage between stock's market beta and its cost of equity. The beta controls for systematic risk. We estimate each firm's *Beta* based on the market model using the value-weighted CRSP index and a minimum of twenty-four monthly returns[4] over the prior sixty months of that firm. We expect the coefficient on $Beta_{t-1}$ to be positive if the return demanded by shareholders increases because of the market risk.

Leverage

[4] Campell, Dhaliwal, and Schwartz (2012) use a minimum of twenty-four monthly returns.

Modigliani and Miller (1958) theorize that a firm's cost of equity to be positively associated with the debt proportion in its capital structure. Fama and French (1992) empirically demonstrate that the ex post mean stock returns is an increasing function of market leverage. Campell, Dhaliwal, and Schwartz (2012) also document a positive relation between implied cost of equity capital and leverage. In this paper we define *Leverage* as the ratio of total book value of liabilities to the market value of equity.

Size

We expect *Size* to be inversely related to the cost of capital because large firms are associated with lower default risk, resulting in lesser required yields by the equity holders. We use the natural log of the book value of assets to measure firm size.

BooktoMkt

BooktoMkt represents the ratio of book value of equity to market value of equity, and it controls for growth opportunities. Prior studies (see, e.g., Fama and French, 1992; Berk, Green, and Naik, 1999) find that *BooktoMkt* is positively related to ex post stock returns. Some researchers (see, e.g., Lakonishok, Shleifer, and Vishny, 1994) even claim that the stocks with high *BooktoMkt* ratios should earn an abnormally high implied risk premium if they are undervalued. Therefore, we posit a positive link between $BooktoMkt_{t-1}$ and ΔICC.

LongGrow

LongGrow is the firm's mean long-term earnings growth rate based on analysts' forecast retrieved from I/B/E/S, and we use it as an additional control for growth opportunities. La Porta (1996) documents an inverse relation between the firm's *LongGrow* and its future stock returns.

He argues that the overly optimistic earnings forecasts of analysts contribute to this phenomenon. Campell, Dhaliwal, and Schwartz (2012) also find a significant negative linkage. In contrast, Gode and Mohanram (2003) claim that the impact of *LongGrow* on the cost of equity capital is difficult to predict. Gebhardt, Lee, and Swaminathan (2001) observe a sign reversion on *LongGrow*. Consequently, the sign of $LongGrow_{t-1}$ is subject to empirical tests.

Foredispers

The fluctuation of firms' earnings has been widely considered as a source of firm valuation risk by financial practitioners (see, e.g., Madden, 1998). In addition, earnings variability is a fairly good measure for cash flow risk. We use *Foredispers* as a proxy for earnings variability, controlling for information asymmetry. It is the analyst forecast dispersion calculated as the natural logarithm of the standard deviation of analyst earnings forecasts for next year divided by the consensus earnings estimate for the same period. Miller (1997) predicts that the firms with high dispersion of analyst forecasts incur lower cost of capital in a capital market where there exists short-sale constraints and heterogeneous expectations. Gebhardt, Lee, and Swaminathan (2001)'s result is consistent with Miller's theory. On the other hand, Zhang (2006) argues that if the variation of analyst forecasts signals increased information uncertainty, the sign should be positive. Therefore, we make no prediction on the direction of relation.

Life

To control for the potential differences of industry sectors which have impact on ΔICC, we include an insurance sub-industry dummy variable, *Life*, to follow the precedent in Hoyt and Liebenberg (2011). *Life* is equal to one for life insurance companies with SIC code 6311, and zero for non-life insurance companies.

Sector_ICC

Prior studies find that a firm's cost of equity capital is significantly affected by the average cost of equity capital in its industry. Even though we focus only on a single industry, the insurance industry has several sectors that operate differently from each other and have disparate business models. Accordingly, we divide insurance industry into five separate sectors defined by SIC codes, and calculate the mean cost of equity capital in each year for each sector. With regard to the sub-industry classification, we categorize the SIC code of 6311 (life insurers) as sector 1, 6321 and 6324 (accident and health insurers) as sector 2, 6331 and 6399 (property and casualty insurers) as sector 3, 6351 (surety insurers) as sector 4, and 6361 (title insurers) as sector 5. Dhaliwal, Krull, and Li (2007) and Campell, Dhaliwal, and Schwartz (2012) document a positive relation between the firm's cost of capital and it's industry cost of capital. Therefore, we posit a positive sign on $Sector\_ICC_{t-1}$.

In addition, we include year dummies in the *ΔICC* equation to control for time variation in the cost of capital over the long period of time.

Discussion of ERM Determinants

We put common explanatory variables from previous research in the ERM model (see, e.g., Hoyt and Liebenberg, 2011; Pagach and Warr, 2011).

Size

Prior studies provide evidence that ERM adopters tend to be large firms (see, e.g., Colquitt, Hoyt, and Lee, 1999; Hoyt, Merkley, and Thiessen, 2001; Beasley, Clune, and Hermanson, 2005; Standard & Poor's, 2005). The reasons suggested include that 1) large firms are more complex, which require special risk treatment; 2) they face a wide spectrum of risks that necessitate the integrated ERM program; and 3) they have the financial ability to afford the administrative expenses demanded by ERM implementation. We use the natural log of the book value of assets as a proxy for firm size.

Leverage

There exist offsetting effects of firms' financial leverage on ERM adoption. On one hand, firms with low leverage have lower default risk. These firms have sufficient capital and are in a good shape in terms of financial status. They tend to have good credit rating. Since ERM is explicitly included in the benchmarks of rating process by Standard & Poor's, firms with low leverage may retain or further boost their ratings by engaging in ERM programs. In addition, their adequate capital supports the expenses related to ERM adoption. On the other hand, firms with greater financial risk have better needs for the ERM program to treat their risks. Therefore, the sign of financial leverage is depend on which of the offsetting effects prevails. Pagach and Warr (2010) document leverage as an insignificant determinant of chief risk officer (CRO) hires in both full sample and financial firms subsample. Liebenberg and Hoyt (2003) find a positive linkage between financial leverage and CRO appointment, while Hoyt and Liebenberg (2011) show an inverse relation. *Leverage* is defined as the ratio of total book value of liabilities divided by the market value of equity.

BooktoMkt

BooktoMkt represents the ratio of the book value to the market value of equity. Firms with high *BooktoMkt* are regarded as value stocks, and those with low *BooktoMkt* are considered as growth stocks. Value stocks do not have as many growth opportunities as growth stocks because they are usually large established firms, which have already past the fast expansion period. They experience reasonable and steady growth, and have predictable and consistent cash flows. We expect these firms with high book-to-market ratio to have complicated business operations and a wide range of risks, which justify the ERM adoption. In addition, their adequate cash flows support the expenses and overheads associated with implementing ERM. From the empirical perspective, it significantly explains the ERM adoption when we run an OLS regression of *ERM* on *BooktoMkt* as the only independent variable. However, Hoyt and Liebenberg (2011) do not include *BooktoMkt* in their ERM equation. We argue that *BooktoMkt* is an important control variable that should not be omitted in the ERM equation[5].

Div_Int

Standard & Poor's (2005) suggest that more complex insurers are likely to benefit more from ERM implementations. In addition to size, diversification contributes to a firm's complexity. We expect internationally diversified firms involve more complex operations. Following Hoyt and Liebenberg (2011) we use *Div_Int* to measure the international diversification, which is equal to 1 for firms with non-U.S. geographic segments, and 0 for those with only domestic geographic segments. We posit a positive sign for the international diversification measure.

Non-ins

We use *Non-ins* to reflect whether a firm has business outside of insurance industry, which is an indicator variable with value one for firms with non-insurance operating segments (SIC codes less than 6311 or greater than 6399), and zero otherwise.

[5] As a robustness check, we run the treatment effects model again without the *BooktoMkt* in the ERM model, the *ERM* variable is still negatively significant at 1% level, and the results on the model as a whole are similar.

Life

To control for the potential differences in the likelihood of ERM adoption related to different sectors within the insurance industry, we include an indicator equal to one for life insurance firms with SIC code 6311, and zero otherwise.

Opacity

Opacity could be financially detrimental to firms. Pottier and Sommer (2006) claim that some insurers are more difficult for outside investors to evaluate due to their opaqueness, which involves more evaluation costs. Pagach and Warr (2010, 2011) argue that opaque assets convey greater amount of asymmetric information, and thus have better chance to be undervalued. Therefore, this class of assets has to be sold at larger discount in the case of financial distress. Since ERM adoptions facilitate the communication of risk management goals and strategies between firms and outside investors, Liebenberg and Hoyt (2003) contend that relative opaque firms derive more benefits through ERM implementations. We measure opacity as the fraction of intangible assets to the book value of total assets.[6]

Slack

Pagach and Warr (2010, 2011) note that ERM's focus on the reduction of firm default risk may result in better levels of financial slack for ERM adopters. On the contrary, they also argue that enhanced risk management quality from ERM implementation may enable firms to decrease their financial slack level. Hoyt and Liebenberg (2011) also include such a variable in their analysis. *Slack* is measured as the proportion of cash and marketable securities in total assets.

[6] This measure captures assets opacity. Some other variables in our model, including *Size* and *Div_Int*, capture some another source of opacity arising from operational complexity.

CV(EBIT) and *RetVolatility*

Prior studies theorize the variability of earnings or stock returns as a determinant for CRO hires or ERM engagement (see, e.g., Liebenberg and Hoyt, 2003; Hoyt and Liebenberg, 2011; Pagach and Warr, 2010, 2011). However, the sign of these two volatility variables is unpredictable due to the same reason associated with *Leverage* and *Slack*—there exists offsetting effects. On one hand, one of the key benefits of ERM is to stabilize earnings or stock returns. Therefore, firms with higher volatility are more likely to engage in an ERM program to enjoy the reduction in volatility. On the other hand, ERM users are likely to benefit from the adoption by experiencing lower stock earnings or returns volatility. In order to measure earnings variability, we use the coefficient of variation of quarterly earnings before interest and taxes in the previous three years (*CV(EBIT)*). As for stock returns volatility, we use the natural logarithm of the standard deviation of monthly stock returns for the year (*RetVolatility*).

ValueChange

ValueChange is measured as the 1-year percentage change in market value of the firm where market value is calculated as the multiple of year-end shares outstanding and closing stock price. Hoyt and Liebenberg (2011) provide strong evidence that ERM is a value-enhancing activity, and accordingly ERM users' market value is expected to increase. They also find that the positive relation between *ValueChange* and ERM adoption is marginally significant. However, Pagach and Warr (2011) argue that if a firm in a tough financial situation engages in ERM to prevent further value reduction, its shareholder value may experience a sharp downturn due to the signaling revelation of its financial status. Therefore, the predicted sign is ambiguous.

Lastly, we include year dummies in the *ERM* equation to control for time variation in the inclination of firms to implement ERM programs.

Table 1 summarizes the variables in the study. Table 2 shows the descriptive statistics for all variables used in the regression. Many of the statistics are similar to those reported by Hoyt and Liebenberg (2011) and Cummins and Phillips (2005).

Results

Univariate Analysis

Means and medians of all variables across ERM adoption status are reported in Table 3. Their respective differences between ERM users and non-users are reported as well. The univariate results provide preliminary evidence that ERM reduces firm's cost of capital growth. In the mean and median analysis, insurers engaged in ERM programs experience decreased growth of implied cost of equity capital. Even though it is insignificant, it heads to the expected direction. After controlling for the endogeneity and firm-level clustering problems, the results should be more accurate. On average, the cost of capital growth for ERM insurers is 0.7 percent lower than that for their counterparts. Moreover, ERM adopters are systematically different from non-adopters. More precisely, with regard to their financial characteristics, the insurers with ERM implementation is larger, more leveraged, and more internationally diversified; has larger market beta, higher book-to-market ratio, more financial slack, and lower return volatility than the other insurers. In addition, as for the analyst forecast estimates, ERM adopters tend to have lower forecasted long-term growth rate and marginally less analyst forecast dispersion than non-adopters.

Industry-Adjusted Cost of Capital Following Firm's Adoption of ERM

In order to investigate whether firms' implied cost of capital significantly decreases around the implementation of the ERM program, we conduct an event study by testing for the significance in the *ICC* changes centered by the event of ERM adoptions. The *ICC* change measure is adjusted for the average time trend in the industry in three different ways. The null hypothesis of our *t*-test states that the mean of the industry-adjusted change in *ICC* specified in Equation (4) is not significantly different from zero. The Wilcoxon signed-ranks test examines a similar version for median. From the results reported in Table 4, we find that the mean and median changes of implied cost of capital are negative and significantly different from zero in multiple event windows, demonstrating that significant drop in firms' implied cost of capital indeed accompanies ERM engagement. More precisely, we use five event windows around the years that firms adopted ERM, which compare the change in firms' cost of capital between up to three years after and one year before the ERM implementation. We have most significant results in (t - 1, t + 1) and (t - 1, t + 2) windows, where both means and medians in all three ways to classify the insurance industry in calculating industry average *ICC* are mostly significant at 1% level. These two windows are the most representative and appropriate ones to examine from the event study perspective, since they allow sufficient but not too lengthy period for ERM to impact on cost of capital. On average, the reduction in the firm's cost of capital between one year after and one year before the ERM adoption ranges from 1.6 to 1.8 percentage points.

Treatment Effects Model Results

Table 5 exhibits the results of the maximum-likelihood treatment effects model that consists of two simultaneously estimated equations. The estimation results for the *ΔICC* equation are reported in the first column. In the first place, the coefficient of *ERM* is negative and significant at 1% level, which supports our primary hypothesis that ERM adoption reduces the cost of equity capital for firms. From the univariate analysis (Table 3) and event study (Table 4) we observe that the ERM firms experience reduction in cost of capital, while non-ERM adopters incur growth in cost of capital. The coefficient estimate in the treatment effects model shows that the difference in cost of capital reduction of ERM-adopted insurers and the growth of their counterparts is highly significant, after controlling for other *ICC* determinants and correcting for the endogeneity problem. From the economic view, the cost of capital change in this two-year window (t - 1, t + 1) between adopters and non-adopters because of ERM engagement is as big as 5.9 percent points. In regard of our control variables, we find that large firms are associated with higher implied cost of capital growth than the smaller firms[7]. The positive relation between firm size and the implied cost of capital is consistent with the findings in some model specifications in Gebhardt, Lee, and Swaminathan (2001). We also find a significant negative relation between the *Foredispers* and the change in cost of capital. This is consistent with Miller (1977)'s theoretical prediction and Gebhardt, Lee, and Swaminathan (2001) empirical analysis. Moreover, the life insurer indicator is negatively significant. It shows that the cost of capital growth of life insurers is significantly lower than the non-life insurers. Lastly, as expected the insurance sector average cost of capital is positively correlated with the firm's cost of capital growth. This positive sign is consistent with prior literature.

The results for the *ERM* equation are reported in the second column of Table 5. In accordance with our univariate results, *Size*, *BooktoMkt*, and *ValueChange* are significantly associated with ERM adoption. In addition, we find that *Leverage* and *Non-ins* are also significant determinants. Specifically, consistent with prior literature we find that larger firms are more likely to engage in the ERM program. We also provide evidence that firms with less

[7] It does not mean that the cost of capital level of large firms is higher than the smaller firms. Large firms may have a lower cost of capital level, but it either increases faster or decreases slower.

leverage or greater book-to-market ratio are more likely to be ERM users. These firms are usually established large firms with predictable and consistent cash flows. They adopt ERM to address the business complexities, and have the sufficient cash capability for the ERM-related expenses and overheads. Consistent with the finding in Hoyt and Liebenberg (2011), we document that firms that enjoy a positive growth in market value are more likely to engage in ERM. Finally, *Non-ins* is negatively and significantly related to ERM implementation, indicating the firms with non-insurance businesses are less likely to adopt ERM. So far the majority of ERM adopters have been in financial industry. The firms with non-insurance operations may not primarily focus in insurance or more broadly financial services industry. Then the top management of these firms may simply not believe in ERM programs by not adopting them.

Finally, through the Wald test we find that the residuals from Equations (5) and (6) are not independent, which justifies our usage of the simultaneous equation system.

In the treatment effects model, we emphasize on the firms that change their status from non-ERM to ERM adopters, and drop all the years after ERM adoptions. We also keep all the firm-years of non-ERM adopters and those of ERM adopters before they implement ERM. However, Hoyt and Liebenberg (2011) retain all the observations after ERM adoptions for ERM users in their treatment effects model. As a robustness check, we also extend our sample according to the criteria in Hoyt and Liebenberg (2011) and run the model again. The extended sample includes 754 observations and 140 firms. Table 6 reports the results. The coefficients and signs are very similar to those in our primary sample in Table 5. Most importantly, *ΔICC* still has the negative significant relation with *ERM* at the 1% level. The difference in cost of capital change between ERM users and non-ERM users is 6.5 percent points, which is even larger than the estimate in the primary sample (5.9 percent points). There is one more significant variable *Opacity*. In line with the prior studies, we provide evidence that less opaque firms are more likely to engage in ERM programs. Hoyt and Liebenberg (2011) document the same relation, but the test is insignificant.

Conclusion

ERM is a process that manages all risks faced by the firm in an integrated, holistic fashion. It has been argued that the resulting synergies between the different risk management activities, the focus on maintaining the probability of large negative cash flows within acceptable limits, and the improved transparency about the firm's risk profile lead to a reduction in the firm's cost of external financing, which increases firm value. To provide the first empirical support for this argument, our research directly examines the relationship between ERM adoption and firms' cost of equity capital.

Our analysis is based on the sample of publicly traded U.S. insurance companies; focusing on just one industry avoids possible spurious correlations caused by unobservable differences across industries. We calculate firm's cost of capital by equating the firm's market value of equity with its discounted future cash flow estimates and solving for the required internal rate of return. We then test for an abnormal reduction in the cost of capital around the year of ERM adoption using multiple event windows, and we estimate a two-equation treatment effects model to assess the effect of ERM on firms' cost of capital. In both tests, ERM adoption is significantly associated with a reduction in firms' cost of capital. Overall, our results indicate that cost of capital benefits are one answer to the question how ERM can create firm value.

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Figure 1
Insurers' Median Implied Cost of Equity Capital Over Time

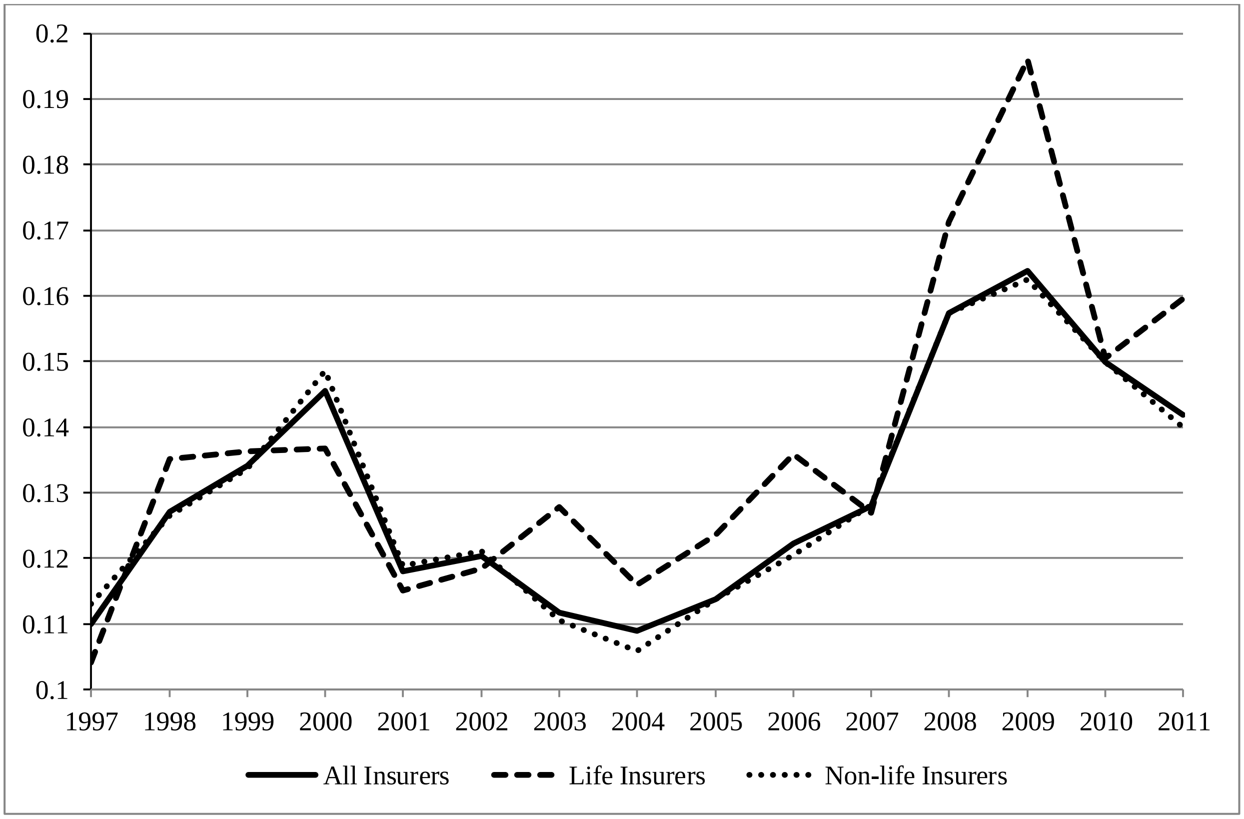
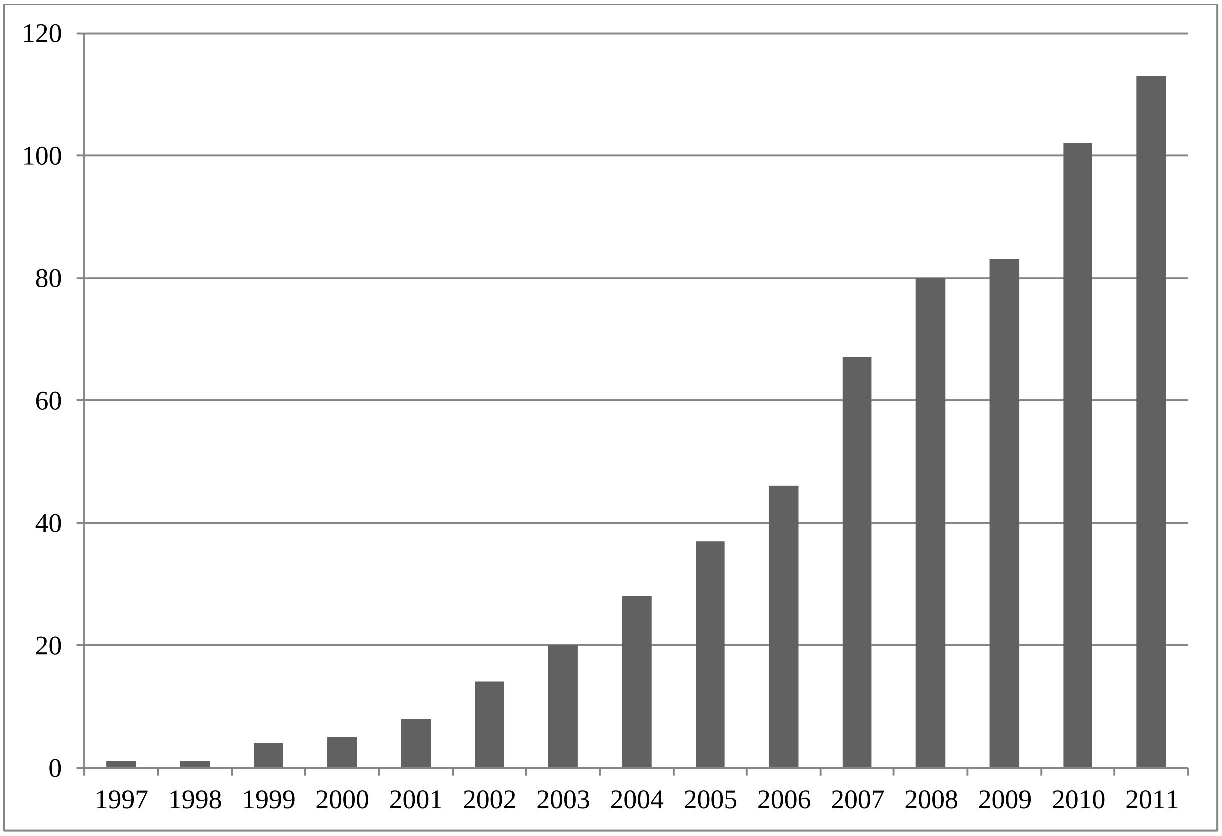


Figure 2
Cumulative Numbers of Sample Insurers Engaged in ERM by Year



Notes: The sample is based on the event studies of changes in firms' cost of equity capital around the adoption of ERM program. By 2011 there are 113 insurance companies engaged in ERM that have the industry-adjusted *ICC* measure.

Table 1
Variable Definitions

Variable Name	Definition	Source
ΔICC	Change in firm's ex-ante implied cost of equity capital from year *t*-1 to year *t*+1 calculated as in Gebhardt, Lee, and Swaminathan (2001) (see Equation (1)-(3) and the related discussion in the text)	I/B/E/S, Compustat, and CRSP
ERM	= 1 for firm-years > = year of first identifiable ERM activity, 0 otherwise	LexisNexis, Factiva, SEC filings, and other media
Beta	Beta estimated with the market model with a minimum of twenty-four monthly returns over the sixty prior months, using a value-weighted market index return	CRSP monthly stock files, Federal Reserve Board
Size	ln (Book value of assets)	Compustat (AT)
Leverage	Book value of liabilities / Market value of equity	Compustat ([AT − CEQ] / [PRCC × CSHO])
BooktoMkt	Book value of equity / Market value of equity	Compustat (CEQ / [PRCC × CSHO])
LongGrow	Firm's mean long-term growth forecast available in I/B/E/S	I/B/E/S
Foredispers	Ln (standard deviation of analyst estimates for next period's earnings / the consensus forecast for next period's earnings)	I/B/E/S
Life	= 1 if the SIC code = 6311, 0 otherwise	Compustat Segment database
Sector_ICC	Average implied cost of equity capital in five different insurance sectors. We classify the SIC code of 6311 as sector 1, 6321 and 6324 as sector 2, 6331 and 6399 as sector 3, 6351 as sector 4, and 6361 as sector 5.	I/B/E/S, Compustat, and CRSP
Div_int	= 1 if positive sales outside of North America, 0 otherwise	Compustat Segment database
Non-ins	= 1 if positive sales in noninsurance SIC codes (< 6311, > 6399), 0 otherwise	Compustat Segment database
Opacity	Intangible assets / Book value of assets	Compustat (INTAN / AT)
Slack	Cash and short-term investments / Book value of assets	Compustat (CHE / AT)
CV(EBIT)	Coefficient of variation of quarterly earnings before interest and taxes in the past three years	Compustat (OIADPQ)
RetVolatility	ln [standard deviation of monthly returns of the year]	CRSP monthly stock files
ValueChange	Firm value in year *t* – firm value in year *t*−1 / firm value in year *t*−1	Compustat ($PRCC_t \times CSHO_t$ – $PRCC_{t-1} \times CSHO_{t-1}$)

Table 2
Summary Statistics

	N	Mean	Std. Dev.	1st Quartile	Median	3rd Quartile
ΔICC	511	0.00134	0.06754	-0.01799	0.00201	0.02163
ERM	511	0.10372	0.30519	0.00000	0.00000	0.00000
$Beta_{t-1}$	511	0.66536	0.41211	0.37197	0.62297	0.90754
$Size_{t-1}$	511	8.54683	1.71484	7.36311	8.39019	9.64918
$Leverage_{t-1}$	511	3.67938	4.97839	1.10672	2.03164	4.32574
$BooktoMkt_{t-1}$	511	0.73984	0.38686	0.50741	0.66001	0.91696
$LongGrow_{t-1}$	511	12.18706	3.41817	10.00000	12.00000	13.75000
$Foredispers_{t-1}$	511	-3.97895	1.08757	-4.70953	-4.07187	-3.39115
$Life_{t-1}$	511	0.14481	0.35226	0.00000	0.00000	0.00000
$Sector\_ICC_{t-1}$	511	0.14650	0.01111	0.13882	0.14607	0.14607
Div_int_{t-1}	511	0.21918	0.41409	0.00000	0.00000	0.00000
$Non\text{-}ins_{t-1}$	511	0.54990	0.49799	0.00000	1.00000	1.00000
$Opacity_{t-1}$	511	0.04619	0.08805	0.00000	0.01012	0.03754
$Slack_{t-1}$	511	0.12643	0.15204	0.03743	0.07189	0.13804
$CV(EBIT)_{t-1}$	511	0.50000	3.01964	0.22227	0.37114	0.71672
$RetVolatility_{t-1}$	511	-2.52461	0.47892	-2.84181	-2.53302	-2.21702
$ValueChange_{t-1}$	511	0.19898	0.53788	-0.09738	0.11174	0.37087

Notes: *ΔICC* is the change in firm's ex-ante implied cost of equity capital from year *t*-1 to year *t*+1 calculated as in Gebhardt, Lee, and Swaminathan (2001) (see Equation (1)-(3) and the related discussion in the text). *ERM* is an indicator variable that takes the value of 1 for firm-years starting from the first year of firms' ERM adoption, and 0 otherwise. ERM classification is based on a comprehensive search of SEC filings, annual reports, newswires, and other media. *Beta* is the capital market beta estimated based on the market model using a minimum of twenty-four monthly returns over the sixty prior months along with the value-weighted market index. *Size* is measured as the natural log of the book value of assets. *Leverage* is the fraction of the book value of liabilities to the market value of equity. *BooktoMkt* is defined as the ratio of the book value of equity to market value of equity. *LongGrow* is the firm's mean long-term growth rate by analysts' forecast from I/B/E/S. *Foredispers* is calculated as the natural logarithm of the standard deviation of analyst earnings forecasts for next year divided by the consensus earnings estimate for the same period. *Life* is an indicator for life insurance companies, with the SIC code 6311. *Sector_ICC* is the average implied cost of equity capital in five different insurance sectors. We classify the SIC code of 6311 as sector 1, 6321 and 6324 as sector 2, 6331 and 6399 as sector 3, 6351 as sector 4, and 6361 as sector 5. *Div_Int* is used to measure the international diversification, which is equal to 1 for firms with non-U.S. geographic segments, and 0 for those with only domestic geographic segments. *Non-ins* is an indicator variable with value 1 for for firm-years with positive sales outside the insurance industry (SIC codes < 6311, > 6399), and 0 otherwise. *Opacity* is equal to the ratio of intangible assets to the book value of assets. *Slack* is the fraction of cash and short-term investments in the book value of assets. *CV(EBIT)* is equal to the coefficient of variation of quarterly earnings before interest and taxes in the previous three years. *RetVolatility* is measured as the natural log of the standard deviation of monthly stock returns of the year. *ValueChange* is defined as (firm $value_t$ − firm $value_{t-1}$) / firm $value_{t-1}$. Accounting and market data are collected from the Compustat Industrial and Compustat Segments databases. Firm and market returns are taken from the CRSP monthly stock database. Analysts' EPS forecasts are collected from I/B/E/S.

Table 3
Univariate Differences across ERM Status

	(1) ERM = 1		(2) ERM = 0		Difference (1) - (2)			
Variable	*Mean*	*Median*	*Mean*	*Median*	*Mean*		*Median*	
ΔICC	-0.00503	0.00034	0.00207	0.00228	-0.00711		-0.00194	
$Beta_{t-1}$	0.79626	0.77484	0.65021	0.60476	0.14606	**	0.17008	***
$Size_{t-1}$	9.52347	9.51520	8.43381	8.31123	1.08966	***	1.20397	***
$Leverage_{t-1}$	4.66672	2.75457	3.56513	1.97565	1.10159		0.77892	***
$BooktoMkt_{t-1}$	0.77145	0.75741	0.73618	0.64340	0.03527		0.11401	***
$LongGrow_{t-1}$	11.37302	11.44000	12.28127	12.00000	-0.90825	*	-0.56000	***
$Foredispers_{t-1}$	-4.10870	-4.21398	-3.96393	-4.04446	-0.14477		-0.16952	*
$Life_{t-1}$	0.16981	0.00000	0.14192	0.00000	0.02789		0.00000	*
$Sector\_ICC_{t-1}$	0.14732	0.14607	0.14641	0.14607	0.00091		0.00000	
Div_int_{t-1}	0.37736	0.00000	0.20087	0.00000	0.17649	***	0.00000	***
$Non\text{-}ins_{t-1}$	0.49057	0.00000	0.55677	1.00000	-0.0662		-1.00000	
$Opacity_{t-1}$	0.03534	0.00833	0.04744	0.01065	-0.01211		-0.00232	
$Slack_{t-1}$	0.11467	0.08453	0.12779	0.07077	-0.01312		0.01376	**
$CV(EBIT)_{t-1}$	0.16536	0.43310	0.53873	0.36569	-0.37337		0.06741	***
$RetVolatility_{t-1}$	-2.65460	-2.71294	-2.50957	-2.50942	-0.14503	**	-0.20352	***
$ValueChange_{t-1}$	0.17373	0.12099	0.20190	0.10174	-0.02817		0.01925	***
No. of observations	53		458					

Notes: *ERM* is an indicator variable that takes the value of 1 for firm-years starting from the first year of firms' ERM adoption, and 0 otherwise. ERM classification is based on a comprehensive search of SEC filings, annual reports, newswires, and other media. *ΔICC* is the change in firm's ex-ante implied cost of equity capital from year *t*-1 to year *t*+1 calculated as in Gebhardt, Lee, and Swaminathan (2001) (see Equation (1)-(3) and the related discussion in the text). *Beta* is the capital market beta estimated based on the market model using a minimum of twenty-four monthly returns over the sixty prior months along with the value-weighted market index. *Size* is measured as the natural log of the book value of assets. *Leverage* is the fraction of the book value of liabilities to the market value of equity. *BooktoMkt* is defined as the ratio of the book value of equity to market value of equity. *LongGrow* is the firm's mean long-term growth rate by analysts' forecast from I/B/E/S. *Foredispers* is calculated as the natural logarithm of the standard deviation of analyst earnings forecasts for next year divided by the consensus earnings estimate for the same period. *Life* is an indicator for life insurance companies, with the SIC code 6311. *Sector_ICC* is the average implied cost of equity capital in five different insurance sectors. We classify the SIC code of 6311 as sector 1, 6321 and 6324 as sector 2, 6331 and 6399 as sector 3, 6351 as sector 4, and 6361 as sector 5. *Div_Int* is used to measure the international diversification, which is equal to 1 for firms with non-U.S. geographic segments, and 0 for those with only domestic geographic segments. *Non-ins* is an indicator variable with value 1 for for firm-years with positive sales outside the insurance industry (SIC codes < 6311, > 6399), and 0 otherwise. *Opacity* is equal to the ratio of intangible assets to the book value of assets. *Slack* is the fraction of cash and short-term investments in the book value of assets. *CV(EBIT)* is equal to the coefficient of variation of quarterly earnings before interest and taxes in the previous three years. *RetVolatility* is measured as the natural log of the standard deviation of monthly stock returns of the year. *ValueChange* is defined as (firm $value_t$ − firm $value_{t-1}$) / firm $value_{t-1}$. Accounting and market data are collected from the Compustat Industrial and Compustat Segments databases. Firm and market returns are taken from the CRSP monthly stock database. Analysts' EPS forecasts are collected from I/B/E/S. ∗∗∗, ∗∗, and ∗ denote statistical significance at the 1, 5, and 10 percent levels, respectively. The *t*-test is used to examine the statistical significance of difference in means. The nonparametric Wilcoxon rank sum test is used to examine the statistical significance of difference in medians.

Table 4
Changes in Implied Cost of Capital Following Firms' Adoption of ERM

Event Windows	No. of ERM Firms	Insurance Industry as a Whole				Two Sectors Defined by Life vs. Non-life				Five Sectors Defined by SIC Codes			
		Mean		*Median*		*Mean*		*Median*		*Mean*		*Median*	
(t-1, t)	73	-0.00853	*	-0.00107		-0.01000	**	-0.00184	*	-0.00734		0.00002	
		(0.076)		(0.256)		(0.038)		(0.077)		(0.130)		(0.402)	
(t, t+1)	88	-0.00405		-0.00594	***	-0.00392		-0.00737	***	-0.00363		-0.00132	
		(0.148)		(0.002)		(0.166)		(0.003)		(0.275)		(0.113)	
(t-1, t+1)	63	-0.01728	***	-0.01001	***	-0.01804	***	-0.00955	***	-0.01595	***	-0.00414	**
		(0.002)		(0.000)		(0.001)		(0.000)		(0.010)		(0.028)	
(t-1, t+2)	51	-0.01518	***	-0.01243	***	-0.01663	***	-0.01236	***	-0.01528	***	-0.01176	***
		(0.001)		(0.001)		(0.000)		(0.001)		(0.003)		(0.003)	
(t-1, t+3)	50	-0.01071	*	-0.00574	**	-0.01162	*	-0.00984	**	-0.01033		-0.00224	*
		(0.082)		(0.022)		(0.065)		(0.018)		(0.102)		(0.070)	

Notes: The null hypotheses are that the mean and/or median of the changes in the industry-adjusted implied cost of equity capital as specified in Equation (4) are not different from zero. Firm *i*'s industry-adjusted *ICC* is the difference between the firm's *ICC* in a particular year and the industry average *ICC* in that year. We use three ways to calculate insurance industry *ICC*. Firstly, we use insurance industry as a whole to calculate the industry average *ICC*. Secondly, we divide insurers into two sectors by life vs. non-life insurers. Lastly, we separate them into five sectors defined by SIC codes. For the second and third methods, after the classifications, we calculate each sector's average *ICC*, respectively, and use them as the minuend to compute the firm's industry-adjusted *ICC*. We use multiple event windows, where *t* denotes the year when a firm adopts ERM. The *t*-test is used to examine the statistical significance of the means, and the Wilcoxon signed-ranks test is employed to examine the statistical significance of the medians; p-values appear in parentheses. ∗∗∗, ∗∗, and ∗ denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 5
Full Maximum-Likelihood Treatment Effects Estimates

	ΔICC (Equation 1)			*ERM* (Equation 2)		
ERM	-0.05941	(0.01956)	***			
Beta$_{t-1}$	-0.00275	(0.00823)				
Size$_{t-1}$	0.00574	(0.00226)	**	0.31575	(0.07125)	***
Leverage$_{t-1}$	-0.00050	(0.00072)		-0.04968	(0.02460)	**
BooktoMkt $_{t-1}$	0.00164	(0.00874)		0.44397	(0.25592)	*
LongGrow$_{t-1}$	0.00144	(0.00113)				
Foredispers$_{t-1}$	-0.00676	(0.00380)	*			
Life$_{t-1}$	-0.04895	(0.02473)	**	0.00432	(0.24317)	
Sector_ICC$_{t-1}$	1.45039	(0.71048)	**			
Div_int$_{t-1}$				-0.07430	(0.19293)	
Non-ins$_{t-1}$				-0.38133	(0.16180)	**
Opacity$_{t-1}$				-1.55925	(0.98590)	
Slack$_{t-1}$				0.10209	(0.48009)	
CV(EBIT)$_{t-1}$				-0.02627	(0.02407)	
RetVolatility$_{t-1}$				-0.11904	(0.16788)	
ValueChange$_{t-1}$				0.22687	(0.12887)	*
Constant	-0.29370	(0.12580)	**	-4.14921	(0.74335)	***
No. of observations	511					
No. of clusters	120					
Log pseudolikelihood	529.18					
Wald test of independent equations	8.27***					

Notes: The sample includes 53 ERM firms with data from one year before until one year after ERM adoption, plus the 458 non-ERM firm-years with data on the same firm for the previous year and the following year. *ΔICC* is the change in firm's ex-ante implied cost of equity capital from year *t*-1 to year *t*+1 calculated as in Gebhardt, Lee, and Swaminathan (2001) (see Equation (1)-(3) and the related discussion in the text). *ERM* is an indicator variable that takes the value of 1 for firm-years starting from the first year of firms' ERM adoption, and 0 otherwise. ERM classification is based on a comprehensive search of SEC filings, annual reports, newswires, and other media. *Beta* is the capital market beta estimated based on the market model using a minimum of twenty-four monthly returns over the sixty prior months along with the value-weighted market index. *Size* is measured as the natural log of the book value of assets. *Leverage* is the fraction of the book value of liabilities to the market value of equity. *BooktoMkt* is defined as the ratio of the book value of equity to market value of equity. *LongGrow* is the firm's mean long-term growth rate by analysts' forecast from I/B/E/S. *Foredispers* is calculated as the natural logarithm of the standard deviation of analyst earnings forecasts for next year divided by the consensus earnings estimate for the same period. *Life* is an indicator for life insurance companies, with the SIC code 6311. *Sector_ICC* is the average implied cost of equity capital in five different insurance sectors. We classify the SIC code of 6311 as sector 1, 6321 and 6324 as sector 2, 6331 and 6399 as sector 3, 6351 as sector 4, and 6361 as sector 5. *Div_Int* is used to measure the international diversification, which is equal to 1 for firms with non-U.S. geographic segments, and 0 for those with only domestic geographic segments. *Non-ins* is an indicator variable with value 1 for for firm-years with positive sales outside the insurance industry (SIC codes < 6311, > 6399), and 0 otherwise. *Opacity* is equal to the ratio of intangible assets to the book value of assets. *Slack* is the fraction of cash and short-term investments in the book value of assets. *CV(EBIT)* is equal to the coefficient of variation of quarterly earnings before interest and taxes in the previous three years. *RetVolatility* is measured as the natural log of the standard deviation of monthly stock returns of the year. *ValueChange* is defined as (firm $value_t$ − firm $value_{t-1}$) / firm $value_{t-1}$. Accounting and market data are collected from the Compustat Industrial and Compustat Segments databases. Firm and market returns are taken from the CRSP monthly stock database. Analysts' EPS forecasts are collected from I/B/E/S. We include the year dummies for 1997–2011 in both equations, but do not report them. Standard errors are adjusted for firm-level clustering, and are reported in parentheses. ∗∗∗, ∗∗, and ∗ denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 6
Full Maximum-Likelihood Treatment Effects Estimates (Extended Sample)

	ΔICC (Equation 1)			*ERM* (Equation 2)		
ERM	-0.06492	(0.01447)	***			
$Beta_{t-1}$	0.00841	(0.00590)				
$Size_{t-1}$	0.01159	(0.00300)	***	0.43243	(0.07005)	***
$Leverage_{t-1}$	-0.00086	(0.00069)		-0.04274	(0.01496)	***
$BooktoMkt_{t-1}$	0.00715	(0.00887)		0.42472	(0.22443)	*
$LongGrow_{t-1}$	0.00098	(0.00074)				
$Foredispers_{t-1}$	-0.00496	(0.00315)				
$Life_{t-1}$	-0.04802	(0.02084)	**	-0.10194	(0.24247)	
$Sector\_ICC_{t-1}$	1.25613	(0.60205)	**			
Div_int_{t-1}				-0.16989	(0.15595)	
$Non\text{-}ins_{t-1}$				-0.34333	(0.18080)	*
$Opacity_{t-1}$				-2.17158	(1.09995)	**
$Slack_{t-1}$				0.15975	(0.55370)	
$CV(EBIT)_{t-1}$				0.00130	(0.00140)	
$RetVolatility_{t-1}$				0.14090	(0.10680)	
$ValueChange_{t-1}$				0.01035	(0.13378)	
Constant	-0.29074	(0.10103)	***	-3.55039	(0.70933)	***
No. of observations			754			
No. of clusters			140			
Log pseudolikelihood			594.61			
Wald test of independent equations			9.58***			

Notes: The extended sample comprises all firm-years with data on the same firm for the previous year and the following year. *ΔICC* is the change in firm's ex-ante implied cost of equity capital from year *t*-1 to year *t*+1 calculated as in Gebhardt, Lee, and Swaminathan (2001) (see Equation (1)-(3) and the related discussion in the text). *ERM* is an indicator variable that takes the value of 1 for firm-years starting from the first year of firms' ERM adoption, and 0 otherwise. ERM classification is based on a comprehensive search of SEC filings, annual reports, newswires, and other media. *Beta* is the capital market beta estimated based on the market model using a minimum of twenty-four monthly returns over the sixty prior months along with the value-weighted market index. *Size* is measured as the natural log of the book value of assets. *Leverage* is the fraction of the book value of liabilities to the market value of equity. *BooktoMkt* is defined as the ratio of the book value of equity to market value of equity. *LongGrow* is the firm's mean long-term growth rate by analysts' forecast from I/B/E/S. *Foredispers* is calculated as the natural logarithm of the standard deviation of analyst earnings forecasts for next year divided by the consensus earnings estimate for the same period. *Life* is an indicator for life insurance companies, with the SIC code 6311. *Sector_ICC* is the average implied cost of equity capital in five different insurance sectors. We classify the SIC code of 6311 as sector 1, 6321 and 6324 as sector 2, 6331 and 6399 as sector 3, 6351 as sector 4, and 6361 as sector 5. *Div_Int* is used to measure the international diversification, which is equal to 1 for firms with non-U.S. geographic segments, and 0 for those with only domestic geographic segments. *Non-ins* is an indicator variable with value 1 for for firm-years with positive sales outside the insurance industry (SIC codes < 6311, > 6399), and 0 otherwise. *Opacity* is equal to the ratio of intangible assets to the book value of assets. *Slack* is the fraction of cash and short-term investments in the book value of assets. *CV(EBIT)* is equal to the coefficient of variation of quarterly earnings before interest and taxes in the previous three years. *RetVolatility* is measured as the natural log of the standard deviation of monthly stock returns of the year. *ValueChange* is defined as (firm $value_t$ − firm $value_{t-1}$) / firm $value_{t-1}$. Accounting and market data are collected from the Compustat Industrial and Compustat Segments databases. Firm and market returns are taken from the CRSP monthly stock database. Analysts' EPS forecasts are collected from I/B/E/S. We include the year dummies for 1997–2011 in both equations, but do not report them. Standard errors are adjusted for firm-level clustering, and are reported in parentheses. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.